



Certificate of Analysis

Standard Reference Material® 187d

Sodium Tetraborate Decahydrate (Borax)

pH Standard

Standard Reference Material® (SRM) 187d is intended for use in preparing solutions for calibrating electrodes for pH measuring systems. SRM 187d, Borax ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$), meets the specifications of the American Chemical Society for reagent grade material. This SRM is certified for pH(S) values **only**. It should not be used as a boron standard, due to loss of water of hydration below the theoretical value ($10\text{H}_2\text{O}$) on storage. SRM 187d is a crystalline material provided in a unit of 30 g.

Certified Values and Uncertainty: The pH(S) values listed below correspond to $\log(1/a_{\text{H}})$, where a_{H} is the conventional activity of the hydrogen (hydronium) ion referred to the standard state ($p^\circ = 1 \text{ atm} = 1.01325 \times 10^5 \text{ Pa}$) on the scale of molality. The values were derived from emf measurements of cells without liquid junction by the method of calculation described in references [1, 2]. The expanded uncertainty at the 95 % confidence level, calculated according to the ISO procedure [3], is less than 0.005 pH units at all temperatures listed. It includes Type B components due to measurements of temperature, pressure, electrode potential, and the gravimetric preparation of standards and Type A components due to the standard deviation of the pH(S) values after smoothing with respect to temperature as described in reference [2], the homogeneity assessment of the SRM material, and the coulometric determination of the molality of HCl used to standardize the electrodes. However, to allow for extra-thermodynamic assumptions in the assignment of pH(S), an uncertainty of 0.005 pH units is assigned to the pH(S) values at all temperatures from 0 °C to 50 °C. **Note:** These certified values apply only to SRM 187d. Small differences in pH(S), typically less than 0.01 unit, can occur between SRM lots.

A solution of SRM 187d with a molality of 0.01 mol/kg with respect to $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ is recommended for the calibration of pH measuring systems (See Preparation of the 0.01 mol/kg Solution). The pH(S) of a 0.01 mol/kg solution of SRM 187d as a function of temperature, t , is presented in Table 1.

Table 1. Certified pH(S) Values and Uncertainties for SRM 187d

$t/^\circ\text{C}$	pH(S)	$t/^\circ\text{C}$	pH(S)	$t/^\circ\text{C}$	pH(S)
0.0	9.461 ± 0.005	20.0	9.227 ± 0.005	40.0	9.073 ± 0.005
5.0	9.393 ± 0.005	25.0	9.182 ± 0.005	45.0	9.043 ± 0.005
10.0	9.331 ± 0.005	30.0	9.142 ± 0.005	50.0	9.015 ± 0.005
15.0	9.276 ± 0.005	35.0	9.106 ± 0.005		

Expiration of Certification: The certification of this SRM is valid until **31 December 2003** within the measurement uncertainties specified, provided the SRM is handled and stored in accordance with the instructions given in this certificate. However, the certification is invalid if the SRM is damaged, contaminated, or modified.

The experimental work leading to the certification of this material was performed by K.W. Pratt of the NIST Analytical Chemistry Division.

Statistical consultation was provided by W.F. Guthrie of the NIST Statistical Engineering Division.

The support aspects involved in the preparation, certification, and issuance of this SRM were coordinated through the Standard Reference Materials Program by J.C. Colbert.

NOTICE AND WARNINGS TO USERS

Maintenance of SRM Certification: NIST will monitor this SRM over the period of its certification. If substantive technical changes occur that affect the certification before the expiration of this certificate, NIST will notify the purchaser. Return of the attached registration card will facilitate notification.

Source of Material: The sodium tetraborate decahydrate was obtained from GFS Chemicals, Powell, OH. This material conforms to the specifications of the American Chemical Society for reagent grade chemicals [4].

Storage: SRM 187d should be stored, as received, in its original container with the cap tightly closed, under normal laboratory conditions. The SRM should not be stored in a desiccator.

INSTRUCTIONS FOR USE

Drying Instructions: Use as received. The salt must not be dried in an oven, nor in a desiccator, before use. The water content of this salt, stored under ordinary conditions, is less than theoretical. This has no significant effect on the pH(S) value, but does affect the boron assay.

Preparation of the 0.01 mol/kg Solution: Gently crush any large lumps of salt. Transfer 3.816 g (mass in air) of SRM 187d to a flask and dissolve in 1.000 kg (mass in air) of distilled carbon dioxide-free water. Alternatively, if volumetric apparatus is to be used, transfer 3.800 g (mass in air) to a 1 L volumetric flask, dissolve in distilled carbon dioxide-free water, and fill to the mark with water at 25 °C. Water, sufficiently carbon dioxide-free, can be prepared by boiling for 10 min and cooling in a vessel guarded by a soda-lime tube. The water should have a conductivity no greater than 2×10^{-6} S/cm. To avoid contamination of the buffer solution with atmospheric carbon dioxide, keep the stopper in place except when removing a portion of the solution. If desired, the solution may be protected with a soda-lime tube.

Stability of Prepared Solution: Solutions are stable for one month. For the highest accuracy, prepare fresh solutions on a weekly basis.

REFERENCES

- [1] Wu, Y.C., Koch, W.F., and Marinenko, G., "A Report on the National Bureau of Standards pH Standards," *J. Res. Natl. Bur. Stand.*, **89**, pg. 395, (1984).
- [2] Wu, Y.C., Koch, W.F., and Durst, R.A., *Standard Reference Materials: Standardization of pH Measurements*, NBS Spec. Publ. 260-53, (February 1988).
- [3] *Guide to the Expression of Uncertainty in Measurement*, ISBN 92-67-10188-9, 1st Ed. ISO, Geneva, Switzerland, (1993): see also Taylor, B.N. and Kuyatt, C.E., "Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results," NIST Technical Note 1297, U.S. Government Printing Office, Washington DC, (1994).
- [4] Reagent Chemicals, 8th Ed., American Chemical Society, Washington DC, (1993).

Users of this SRM should ensure that the certificate in their possession is current. This can be accomplished by contacting the SRM Program at: Telephone (301) 975-6776 (select "Certificates"), Fax (301) 926-4751, e-mail srminfo@nist.gov, or via the Internet <http://ts.nist.gov/srm>.